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Delineating Trauma Mechanisms and Interventions: How Psychological Trauma Difficulties Develop and how they can be Treated Effectively

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**Delineating Trauma Mechanisms and Interventions: How Psychological Trauma
Difficulties Develop and how they can be Treated Effectively**

May 2018

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Evaluating the Effectiveness of Phase-Oriented Treatment Models for Post-Traumatic Stress
Disorder; a Meta-Analysis

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Abstract

It has been suggested that treatments for Post-Traumatic Stress Disorder (PTSD) be framed within a staged or phase-oriented model, particularly in cases of increased trauma symptom severity and Complex PTSD (CPTSD). However, ambiguity remains around this model's definition and efficacy. The present literature review aimed to examine the efficacy of treatments adopting a phase-oriented model for individuals with PTSD symptoms. A systematic search of the literature found 1180 articles, of which 13 met pre-defined criteria. In order to analyse effect sizes, a random effects meta-analysis was conducted. The analysis showed a large effect size in the differences between beginning and end of treatment time points on PTSD symptoms ($d = 1.77$, 95% CI [1.45 to 2.08], $Z = 10.97$; $p < .001$) with moderate heterogeneity. A sub analysis showed that the large effect size was maintained when compared with their inactive control groups ($d = 0.82$, 95% CI [0.29 to 2.29], $Z = 3.04$; $p < .005$). Further sub analysis of a pre-defined high complexity population also revealed a large effect size ($d = 1.39$, 95% CI [0.99 to 1.79], $Z = 6.79$; $p < .001$). Results concurred with previous literature supporting the effectiveness of phase-oriented models for PTSD symptoms but limitations existed in finding appropriate definitions of the model, symptom severity, appropriate control groups, and generalising findings.

Keywords: Post-Traumatic Stress, Treatment, Efficacy, Stabilisation, Exposure

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Evaluating the Effectiveness of Phase-Oriented Treatment Models for Post-Traumatic Stress Disorder; a Meta-Analysis

Current best practice guidelines recommend trauma memory reprocessing and exposure based interventions in the psychological treatment of Post-Traumatic Stress Disorder (PTSD) (NICE, 2005). Several studies have highlighted the efficacy of such unimodal approaches in empirical research (Ehlers, Clark, Hackmann & Grey, 2010; Van der Kolk et al., 2007). Specifically, Trauma Focused Cognitive-Behaviour therapy (CBT) and Eye-Movement Desensitization and Reprocessing (EMDR) have been shown to be most effective treatments for PTSD, maintaining their efficacy at follow up points (Van Etten & Taylor, 1998). Further meta-analyses have also demonstrated that Prolonged Exposure (PE), as well as a broader range of exposure methods, are equally effective at reducing PTSD symptoms (Cusack et al., 2016; Powers, Halpern, Ferenschak, Gillihan, & Foa, 2010).

Whilst these approaches have shown efficacy and large effect sizes in PTSD symptom reduction (Bisson, Roberts, Andrew, Cooper & Lewis, 2013; Cusack et al., 2016; Powers et al.; Seidler & Wagner, 2006), this has often been in populations with relatively circumscribed traumatic experiences, and research trials are less likely to include samples with higher complexity trauma (McFetridge et al., 2017). Furthermore, the large effect size of treatments is reduced in samples where there is heightened trauma severity such as a history of childhood abuse, compared with placebo and inactive controls (Ehring et al., 2014). Therefore, unimodal approaches yielding large effect sizes, such as Trauma Focused CBT, are often supported by evidence for treatments of non-complex presentations and so cannot necessarily be translated to the needs of individuals with complex traumatic reactions (Corrigan & Hull, 2015; van der Kolk, Roth, Pelcovitz, Sunday & Spinazzola, 2005).

When defining and highlighting the difference in PTSD and Complex PTSD authors have stated the need for a separate Complex PTSD (CPTSD) classification, given its unique

symptoms, compared to single incident PTSD (Cloitre et al., 2013). Since then, the anticipated ICD-11 (World Health Organisation, 2018), has added CPTSD as a distinct diagnostic category, characterised by six symptom areas; re-experiencing, avoidance, sense of threat, *as well as* emotion dysregulation, negative self-concept, and interpersonal disturbance symptoms. Most recently, reviews of the literature have supported a distinction between PTSD and CPTSD symptomology (Brewin et al., 2017). It has also been found through empirical literature that trauma type significantly predicts trauma complexity, in that a dose-response relationship has been found in relation to childhood trauma and CPTSD symptoms (Hyland et al., 2017). As described, emotional dysregulation is one symptom area that has been highlighted as fundamentally linked to trauma related pathology (McLean & Foa, 2017; Seligowski, Lee, Bardeen, & Orcutt, 2014). Among the research showing that trauma severity predicts symptom severity (Cloitre, Garvert, Brewin, Bryant, & Maercker, 2013), research showed that childhood trauma increases emotional dysregulation in adulthood along with other CPTSD symptoms (Dvir, Hill, Ford, & Frazier, 2014; McClean & Gallop, 2003; Van der Kolk, Pelcovitz, Roth & Mandel, 1996). This research illustrates that there is an additional set of difficulties associated with increased trauma severity, leading to complex symptoms, which is not addressed by unimodal therapies (Dorahy et al., 2009).

Many clinicians and researchers have asserted that the current evidenced approaches are less effective for CPTSD and could potentially be unsafe if applied to individuals with severe, chronic and CPTSD presentations (Ford, Courtois, Steele, van der Hart, & Nijenhuis, 2005; Matheson, 2016). Furthermore, studies of Trauma Focused CBT and EMDR have shown less favourable outcomes in RCT designs for participants experiencing multiple traumas, social and relationship problems, substance misuse and mood disorders, compared to single incident trauma (Ehlers et al., 2013) and higher dropout in chronic PTSD, as well as childhood trauma (Bisson et al., 2013; Resick, Suvak, & Wells, 2014). Alternatively,

interventions delivered in a phase-oriented approach may be more helpful in this type of population, given that a main treatment target is to first establish stabilisation in the form of managing symptoms, or stabilization (Courtois & Ford, 2013). This approach has been supported by clinicians in a study showing that 84% of experts endorse a phase-oriented treatment approach for CPTSD (Cloitre et al., 2012). Phase-oriented treatment of trauma traditionally adopts three broad stages; 1) stabilisation aimed at providing resources to the client; 2) treatment of trauma memories, usually through exposure and trauma memory reprocessing and (Foa, Keane, Friedman & Cohen, 2008), and 3) reintegration of previous life goals (Herman, 1992). However, although this approach has been well documented and resourced, there exists an on-going debate in the literature, focusing on the efficacy of a phase-oriented approach. The opposing view has suggested that a stabilisation phase is not required as part of a trauma focused intervention, and instead suggests that the current evidence cannot prioritise a phase-oriented approach over a unimodal trauma treatment even in cases of trauma complexity (Bicanic, de Jongh, Broeke, 2015). This has therefore created a division in the field with researchers presenting findings supporting different approaches.

Interventions that adopt a phase-oriented approach have demonstrated clinical efficacy across a range of therapeutic modalities. For example, randomised control studies with trauma samples have shown the superior efficacy of a two-stage treatment model using Skills Training in Affect and Interpersonal Regulation (STAIR) with Prolonged Exposure (Cloitre, Koenen, Cohen & Han, 2002), leading to less drop out on the exposure and trauma memory reprocessing phase (Cloitre et al., 2010). Another phase-oriented approach has been developed using Dialectical Behaviour Therapy with Prolonged Exposure (DBT-PE) (Linehan, 2014) and has been shown to be effective in PTSD samples with histories of childhood abuse and a co-morbid personality disorder diagnosis (Bohus et al., 2013; Harned, Korslund, Foa, & Linehan, 2012). These approaches first implement skills in order to manage

risk taking behaviours, regulate emotions and develop interpersonal skills before continuing into the exposure and trauma memory reprocessing stage of treatment. What should be documented is how this approach differs to unimodal approaches, such as Cognitive Processing Therapy which does not implement a skill set phase before moving into exposure (Resick & Schnicke, 1993). Moreover, the phase-oriented approach differs to exposure protocols which do implement some emotion regulation strategies, such as breathing retraining in Prolonged Exposure (Foa, Hearst, Dancu, Hembree, & Jaycox, 1994), in that the phase-oriented approach advocates a specific stage at the start of the work to develop skills before moving into the exposure stage. Alternatively, Prolonged Exposure uses breathing skills within and to assist the exposure protocol, in that it is intertwined with exposure sessions, rather than developed as a discreet area of treatment.

One of the current questions is the overall efficacy of interventions that employ a phase-oriented approach to PTSD treatment, particularly in relation to CPTSD presentations. In fact, there is a paucity of literature on such interventions and, as yet, no systematic review has examined the extant evidence base. An unsystematic review by Cloitre et al. (2012) found large effect sizes in literature utilizing stabilisation treatments, but only a minority of these studies investigated stabilisation with exposure and trauma memory reprocessing. Therefore, in order to contribute to the debate on the need for phase-oriented approaches, robust meta-analytic reviews are required to bring clarity to the efficacy of the approach, as these reviews already exist within unimodal approaches. Moreover, studies have either implemented inactive control groups, such as waiting lists, or not utilised control groups at all, leading to criticism about how phase-oriented approaches targeting emotion dysregulation before exposure and trauma memory reprocessing impact PTSD outcomes (de Jongh et al., 2016; McLean & Foa, 2017). This highlights a major criticism about the quality of studies used to investigate phase-oriented approaches, in that they have utilised control groups that

do not deliver a unimodal intervention. Therefore, the quality of the studies again highlights the difficulty with inferring superior efficacy of these approaches, limiting their conclusions (de Jongh et al, 2016). Ultimately, however, research does exist supporting a phase-oriented approach, which could address symptom complexity and augment best practice guidelines.

The present review aimed to investigate if psychological interventions adopting a phase-oriented treatment approach were potentially helpful treatments for reducing PTSD symptoms. Secondly, the review aimed to measure if the effect size was maintained when comparing the studies with their control groups. Third, the review aimed to investigate the efficacy of this intervention type in a high complexity PTSD sample.

In light of the research mentioned, a systematic literature review was conducted using the PICOS framework (population, intervention, comparison, outcome, and study design) in order to address the following research question:

What is the efficacy of psychological interventions adopting a phase-oriented approach for treating PTSD symptoms as reported in adults?

Method

Operational Definitions

Considering the lack of agreement on formal definitions of several concepts relevant to this review (e.g., phase-oriented treatment, CPTSD), a set of working definitions were operationalized based on best available evidence in the current literature base. Along with using the PICOS framework, this facilitated the search strategy and created part of the inclusion criteria for the analysis.

Phase-oriented approach

In keeping with mainstream discourse on this approach (Courtois & Ford, 2013; Herman, 1995), an intervention adopting a phase-oriented approach to PTSD was defined as having 2 or more distinct stages. The first phase was conceptualised as an explicit

stabilisation intervention, followed by a second stage of treatment involving exposure and trauma memory reprocessing. In this way, the phase-oriented definition went beyond unimodal protocols (Foa et al., 1994; Rescik & Schnike, 1993) in order to implement a distinct skills phase, before the implementation of an exposure and trauma memory reprocessing treatment. This corresponded to the literature base on interventions which have focused on a two-phase model (Cloitre et al., 2002, 2010; Harned et al., 2014).

Stabilisation

Stabilisation can be conceptualised as providing skills to the client before beginning exposure to the trauma memory and has been deemed an important precursor in complex populations (e.g., CPTSD, childhood trauma) due to the noted difficulties in emotional regulation. In the present study, the stabilisation phase referred to interventions that developed skills in increasing emotion regulation, such as relaxation and breathing skills, as well as manualised skills based approaches such as STAIR and DBT which are distinct from the exposure and trauma memory reprocessing procedures used. Defining stabilisation in terms of affect regulation also corresponds to the symptom cluster associated with CPTSD (WHO, 2018).

Exposure and trauma memory reprocessing

This phase of treatment was defined as any intervention which involved techniques of exposure to the trauma memory and engaged in trauma memory re-processing. This included exposure protocols, such as those used in Prolonged Exposure, Narrative Exposure, Cognitive Processing Therapy, Trauma Focused CBT, and EMDR. Therefore, any study that stated explicitly the use of an intervention focusing on exposure to trauma memory (and meeting the phase-oriented, and stabilisation definitions provided) was considered for inclusion.

Trauma complexity

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A sub-analysis of the efficacy of phase-oriented treatment approaches in more complex populations was conducted. In keeping with the substantive research base linking childhood trauma to CPTSD symptoms (e.g., Dvir, Hill, Ford, & Frazier, 2014; Hyland et al., 2017; McClean & Gallop, 2003; van der Kolk, Pelcovitz, Roth & Mandel, 1996), studies investigating childhood trauma and PTSD symptoms were analysed as a *high complexity* subgroup. This definition was then used when considering studies for a sub-analysis, examining effects of the treatment utilising a phase-oriented model.

Inclusion and Exclusion Criteria

It was proposed that each study met a list of criteria in order to be included in the review. Inclusion criteria were that articles utilised an adult clinical sample, participants had a diagnosis of PTSD or were reporting PTSD symptoms, the measure of efficacy was a measure of PTSD symptoms taken at beginning and end of treatment time points, articles used quantitative analyses, were in the English language, from the year 2000 to present and in a peer reviewed journal. Exclusion criteria were the use of child and adolescent samples, case study designs, qualitative designs, articles not measuring PTSD symptoms, articles in languages other than English, articles before 2000 and not appearing in peer reviewed journals.

Search Strategy

A range of search engines were used to find published research literature. These were Ovid MEDLINE, Ovid PSYCHINFO, and ISI Web of Science. Studies were refined to the January 2000 to January 2018 timeframe to ensure that the interventions were in keeping with current best practices. As the study sought peer reviewed articles to maintain quality, grey literature was not searched. References of the final articles were hand searched to maximise collection. Search terms were based on scoping searches of the literature. Search terms were 1. (Posttraumatic Stress Disorder (subject heading) or Posttraumatic stress

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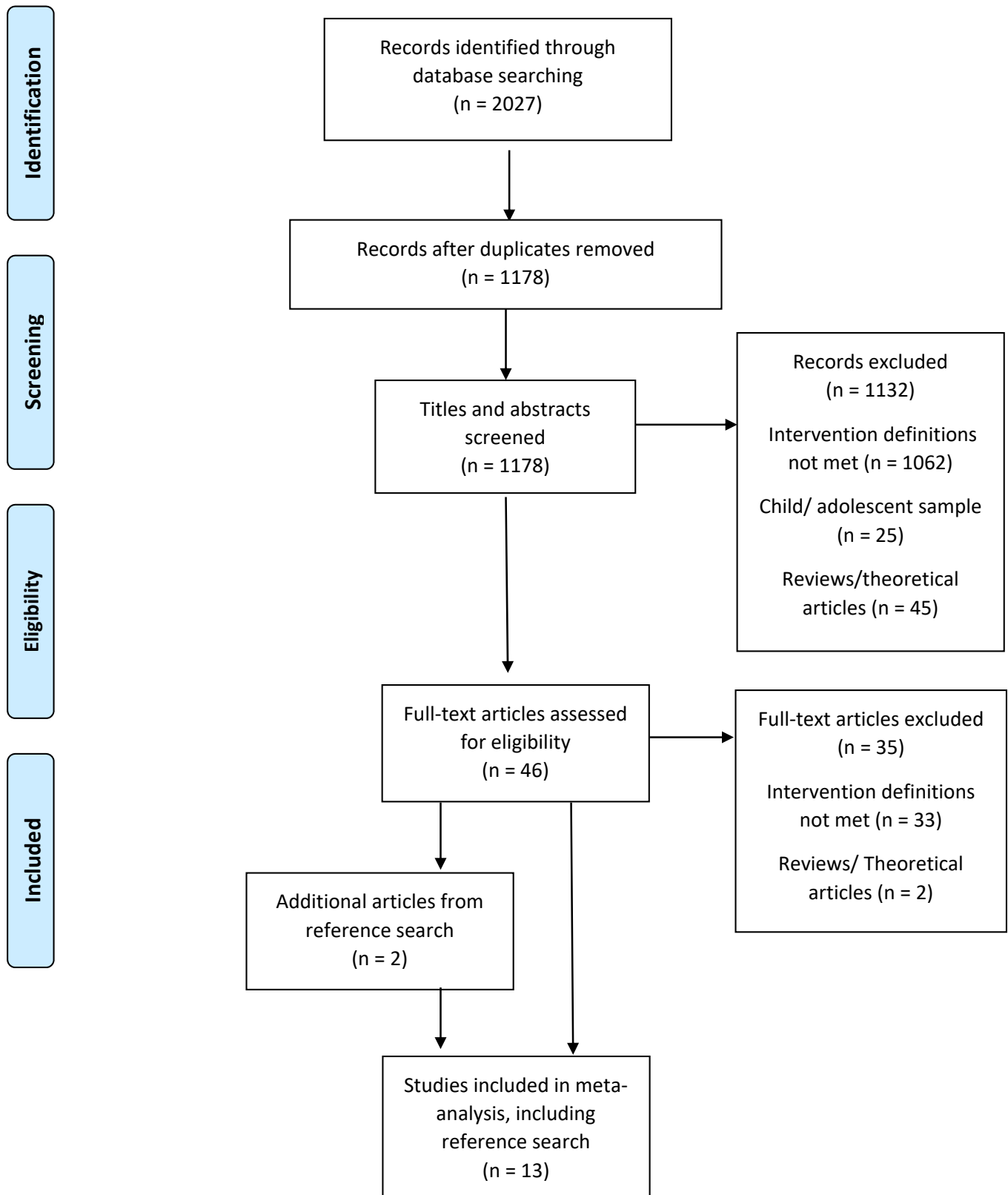
disorder or PTSD (Keywords)), AND 2. (stabilisation OR "emotion regulation" OR "emotion tolerance" OR "emotion management" OR "affect regulation" OR "affect tolerance" or "affect management" OR "stress inoculation" OR relaxation OR "breathing retraining" OR "Dialectical Behaviour Therapy" OR "DBT" OR "skills training" (keywords)) (as well as their truncated versions), OR 3. ("phase oriented" OR "phase based" OR "stage based" OR sequential OR "phase-oriented" OR "phase-based" OR "stage-based" (keywords)). Exposure and trauma memory reprocessing search terms were not added as this may have filtered out studies which did not self-define as using stabilisation or phase-oriented treatments but did in fact meet the definitions of the review.

Identified Articles

The search strategy revealed 2027 studies from the three databases. After duplicates were removed 1178 remained for which titles and abstracts were screened. After screening for eligibility 1132 were excluded (1062 did not meet the parameters of intervention definitions, 25 were studies using child and adolescent samples, 45 were theoretical articles or literature reviews). 46 full text articles were then screened for eligibility and a further 35 were removed (33 did not meet the parameters of the intervention definitions and two articles were theoretical in nature or literature reviews). The references of the final articles were then searched, yielding 2 more appropriate studies, providing a total of 13 eligible studies.

Studies were then assessed for eligibility by an independent rater to ensure consistency and an inter-rater analysis was carried out using the Kappa coefficient. Each study was then cross checked for quality and given a rating on a quality assessment measure (Appendix 2). A meta-analysis was then conducted using Cohen's *d* (Cohen, 1992). Sub-group data was then collected for those studies where a control was used and for studies which described using samples reporting a history of childhood abuse.

Figure 1. PRISMA flowchart



Results

Analysis

Data was analysed using Review Manager (RevMan) version 5 and obtained from the Cochrane Community. Within-group effect sizes (Cohen's d) were calculated for each included study using the Standard Mean Difference, through inputting means and standard deviations at beginning and end of treatment time points on the PTSD symptom measure for the treatment groups. Where possible these were calculated for those participants who had completed measures, rather than the intent-to-treat analysis data. In order to ensure that the effect size was reliable, a sub-analysis of between-group effect sizes was calculated for those studies which utilised a control group. Finally, once an overall effect size had been obtained from the main analysis, a sub-group analysis, utilising within group effect sizes, was carried out on studies where samples consisted of participants reporting childhood abuse. A random effects model provided the average effect size in each analysis.

Study Characteristics

Table 1 outlines the studies included in the analysis. The population is described in terms of its clinical presentation, and as can be seen all samples are reporting PTSD symptoms. The emotion regulation methods used at phase one are described. Duration of this phase lasted up to 1 year. Exposure and trauma memory reprocessing methods used in phase 2 consisted of EMDR, Prolonged Exposure, Imaginal Exposure, Narrative Exposure Therapy, and exposure therapy. Duration of this phase ranged from 3 sessions to 12 sessions. Any additional stabilisation was accounted for and the nature of the phase-oriented treatment described. The outcome measures used were all measures of trauma symptoms. Overall the 13 studies represented 14 phase-oriented treatment conditions, and an overall sample of $n = 227$ at the beginning of treatment and $n = 226$ at the end of the treatment time points.

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The sub analysis of the high complexity studies consisted of DBT and STAIR emotion regulation strategies. Exposure and trauma memory reprocessing interventions were Prolonged Exposure and exposure therapy. Stabilisation interventions varied between 8 sessions and 4 weeks, and exposure and trauma memory reprocessing interventions varied between 8 sessions and 6 weeks. The sub-group sample size was $n = 109$.

Quality of Articles Obtained.

Of the 48 full texts remaining for screening the inter-rater agreement was deemed acceptable; $\kappa = .951$ ($p < .0001$). Each of the studies was considered to have a strong quality rating by both raters (table 2).

Table 2. Classification given by independent rater (Rater 1) and author (Rater 2) after quality of each paper was assessed.

Study	Rater 1 classification	Rater 2 Classification
Bohus et al., 2013	Strong	Strong
Bryant et al., 2013	Strong	Strong
Cloitre et al., 2002	Strong	Strong
Cloitre et al., 2010	Strong	Strong
Crespo & Arinero, 2010	Strong	Strong
Frueh et al., 2009	Strong	Strong
Harned et al., 2012	Strong	Strong
Harned et al., 2014	Strong	Strong
Hinton et al., 2005	Strong	Strong

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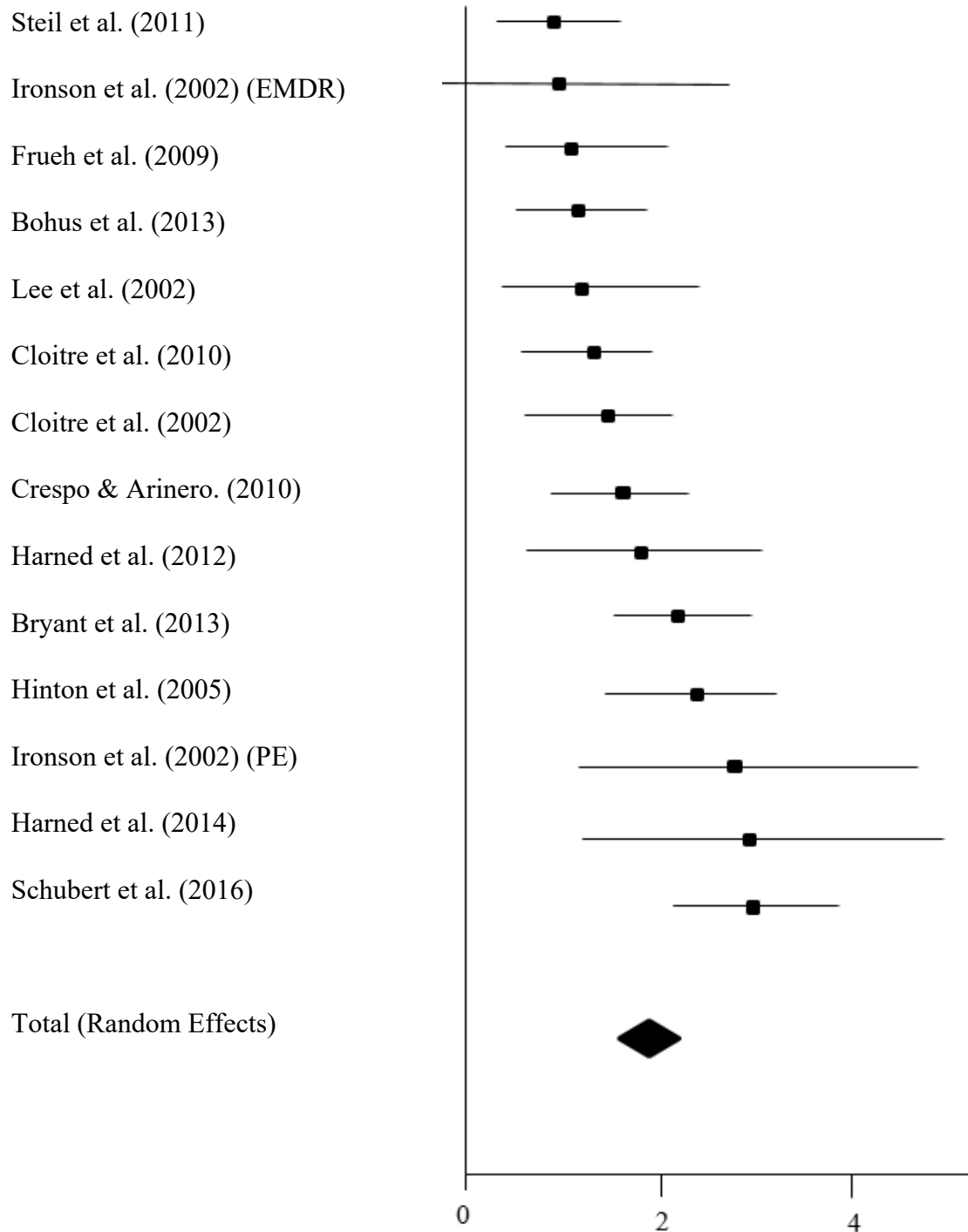
Ironson et al., 2002	Strong	Strong
Lee et al., 2002	Strong	Strong
Schubert et al., 2016	Strong	Strong
Steil et al., 2011	Strong	Strong

Calculations of Effect Size

The overall mean effect size for the 14 interventions was $d = 1.77$ with 95% confidence intervals between 1.45 and 2.08 ($Z = 10.97$; $p < .001$). Effect sizes ranged from $d = 0.82$ to $d = 3.07$. All outcomes showed improvement on PTSD symptoms, which is outlined in the forest plot (figure 2). Moderate heterogeneity was observed between the studies ($Q = 26.88$; $p < .05$), and 52% of the variance in the overall effect size was due to variance between the studies ($I^2 = 52\%$).

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Figure 2. Forest plot containing effect sizes and confidence intervals for overall meta-analysis.



Sub analysis 1; control group comparison

When carrying out the sub-analysis for studies which utilised controls (appendix 1, figure 3), the between group effect size was reduced, although was still classified as large $d = 0.82$ (CI [0.29 to 2.29], $Z = 3.04$; $p < .005$).

Sub analysis 2: high complexity analysis.

Again, when isolating those studies which met the criteria for a high complexity sample (appendix 1, figure 4), a sub analysis of within group effect sizes from before and after treatment revealed a large effect size, $d = 1.39$ (CI [0.99 to 1.79], $Z = 6.79$; $p < .001$).

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Table 1. Study Characteristics.

Author	Population	Control group	ER method	Exposure method	Additional stabilisation	Duration stabilisation	Duration Exposure	Phase-oriented treatment (n)	PTSD Measure used
Bohus et al. (2013) **	Adults with PTSD diagnosis relating to CSA, with and without BPD	Waitlist	DBT skills	Exposure Therapy	DBT - skills training, group intervention, creative arts sessions, and psychoeducation	4 weeks	6 weeks	Stabilisation and Exposure therapy (n=29)	CAPS
Bryant et al. (2013)	Adults with PTSD diagnosis	Supportive counselling	Emotion regulation training	CBT with Imaginal exposure	Psychoeducation	5 sessions	6 sessions	Stabilisation and CBT with Imaginal exposure (n=36) *	CAPS-2
Cloitre et al. (2002) **	Adults with PTSD diagnosis relating to childhood abuse	Waitlist	STAIR	Modified PE	-	8 sessions	8 sessions	Stabilisation and PE (22)	CAPS
Cloitre et al. (2010) **	Adults with PTSD diagnosis relating to childhood	Supportive counselling	STAIR	PE	-	8 sessions	8 sessions	Stabilisation and PE (33) *	CAPS

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abuse									
Crespo, M., & Arinero, M. (2010)	Female victims of intimate partner violence with Post-Traumatic Stress Symptoms	Communication skills	Arousal controlling procedures	Imaginal exposure	Behaviour activation, self-esteem, problem solving, cognitive restructuring	7 sessions	2 sessions	Stabilisation and Imaginal Exposure (n=28)	SPTSS
Frueh et al. (2009)	Adults with schizophrenia or schizoaffective disorder and PTSD diagnosis	-	Anxiety management skills training	Imaginal exposure	Psychoeducation, social skills and communication training	14 sessions	8 sessions	Stabilisation and Imaginal Exposure (n=13)	CAPS
Harned et al. (2012)	Women with BPD, PTSD diagnosis, and self-injury	-	DBT skills	PE	Full DBT protocol	1 year	13 sessions (mean)	Stabilisation and PE (n=7)	PSS-I
Harned et al. (2014)	Women with BPD, PTSD diagnosis, and self-injury	DBT	DBT skills	PE	Full DBT protocol	1 year	12.7 sessions (mean)	Stabilisation and PE (n=5)	PSS-I

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Hinton et al. (2005)	Cambodian adult refugees with treatment resistant PTSD diagnosis and panic attacks	Waitlist	Arousal related reduction skills	Exposure narrative and recall	Psychoeducation, cognitive restructuring	-	-	Stabilisation and Exposure narrative (n=20)	CAPS
Ironson et al. (2002) (EMDR)	Adults with PTSD diagnosis	-	Distress reduction techniques	EMDR	Psychoeducation	2 sessions	3 sessions	Stabilisation and EMDR (n=6)	PSS-SR
Ironson et al. (2002) (PE)	Adults with PTSD diagnosis	-	Distress reduction techniques	PE	Psychoeducation	2 sessions	3 sessions	Stabilisation and PE (n=6)	PSS-SR
Lee et al. (2002)	Adults with PTSD diagnosis (recent trauma)	-	Stress Inoculation Training	PE	-	-	-	Stabilisation and PE (n=12)	IES
Schubert et al. (2016)	Adults exposed to political violence with PTSD symptoms	-	Calm breathing and safe place stabilization techniques	EMDR	-	1 session	10 sessions	Stabilisation and EMDR (n=21)	HTQ

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Steil et al. (2011) **	Adults with PTSD diagnosis relating to CSA, residential treatment	-	DBT skills	Exposure Therapy	DBT group, and psychoeduca tion	-	-	Stabilisation and Exposure therapy (n=25)	PDS
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* = studies only providing intent to treat analysis, ** = studies meeting criteria for high complexity trauma sample, ER Method = emotion regulation method, HTQ = Harvard Trauma Questionnaire, PSS-I = PTSD Symptom Scale-1, CAPS = Clinician Administered PTSD Scale, CAPS-2 = Clinician Administered PTSD Scale-2, PSS-SR = PTSD Symptom Scale-Self Report, IES = Impact of Events Scale, PDS= Post-Traumatic Stress Diagnostic Scale, SPTSS = The Severity of Post-Traumatic Symptom Scale, PDS = Post Traumatic Stress Diagnostic Scale.

Discussion

This review of the literature is the first to have systematically defined and searched for psychological interventions that adopted a phase-oriented approach to trauma therapy and evaluated their overall effect on PTSD symptoms. This analysis showed that phase-oriented treatments, defined first by emotion regulation skills and followed by exposure and trauma memory reprocessing, are effective treatment models for post-traumatic stress symptoms. Through conducting a meta-analysis of 13 studies, for which there were 14 independent treatment groups, the overall effect size was considered to be large (Cohen, 1992). This suggests that there is an improvement in PTSD symptoms when this combined model of intervention is delivered across a range of populations and complexities. Whilst the meta-analysis did not use a comparison group or compare the efficacy of phase-oriented approaches to unimodal interventions (e.g., EMDR), the large effect size was maintained in a sub-analysis comparing treatments with their controls. Moreover, when isolating a sample who met a definition of a “high complexity” population, i.e. childhood trauma, the large effect size was also maintained. Whilst these findings should be taken cautiously, the results suggest that there may be efficacy in using this phase-oriented treatment approach in treating PTSD symptoms and expanding it to evaluate its effectiveness across complex trauma presentations.

Given the research which has shown emotion dysregulation as a fundamental difficulty in PTSD (Seligowski et al., 2014), the current study suggests that implementing a discrete and focussed phase of emotion regulation skills, as well as other stabilisation strategies, before established exposure and trauma memory reprocessing treatments could be of therapeutic benefit, as is advocated in clinical practice texts (Courtois & Ford, 2013; Ford et al., 2005; Herman, 1992). What should be recognised is that although this review compared phase-oriented intervention groups with their controls where possible, these control

groups were mainly inactive. Therefore, it is not possible to say that phase-oriented approaches show higher efficacy than active unimodal approaches. What can be surmised is that when compared with the extant literature, best practice unimodal therapies such as EMDR and Trauma Focused CBT have equivocal effects (Seilder & Wagner, 2006; Bisson et al., 2013) and are comparable with the current study. For example, through large scale meta-analysis, large effect sizes have been found for Trauma Focused CBT ($d = 1.62$) and EMDR ($d = 1.17$) when compared to waitlist controls (Bisson et al., 2013), concurrent with the present results. Furthermore, when delivered to participants with a history of childhood abuse, a meta-analysis of trauma focused treatments revealed a large effect size between start and end of treatment ($g = 1.24$) (Ehring et al., 2014). Again, the beginning to end of treatment large effect size is consistent with the current findings.

The variance in effect sizes across the studies in the present review revealed intricate trends. Some interventions used lengthy and robust evidence based stabilisation methods such as DBT (Steil et al., 2011; Bohus et al., 2013); however, these studies were not consistently revealing the largest effect sizes, bringing in to question their utility. This may be due to the complexity of the presentations in these studies, as DBT has been developed for complex presentations (Linehan, 2014). Furthermore, when looking closer at the control groups used, results showed smaller effect sizes for those studies which utilised active controls, such as communication skills, supportive counselling, or DBT (Bryant et al., 2013; Cloitre et al., 2010; Crespo & Arinero, 2010; Harned et al., 2014). Whereas those studies which used inactive controls, such as a waitlist (Hinton, et al., 2005), showed larger effect sizes, as outlined in figure 3 (appendix 1). This may suggest that effect sizes of interventions are inflated depending on the control group used, and so points to caution when interpreting clinical effectiveness. As more robust categorisations of PTSD develop, such as CPTSD, the relationship between complexity and effect size could be clarified in further research.

Ultimately it should be recognised that explicit phase-oriented approaches have been advocated in the use of higher complexity, rather than single case trauma which was difficult to distinguish in the current study, and so it may be that higher complexity influences treatment outcomes and so requires a specific therapeutic approach (van der Kolk et al., 2005). Even though studies have also shown that stabilisation informed interventions are effective with large effect sizes (Dorrepal et al., 2010; Ford, Steinberg & Zhang, 2011), it is not possible to quantify the added value of stabilisation in this review, or how this compares to a unimodal approach, which has been a shortcoming in previous reviews (Cloitre et al., 2012).

Limitations

There are limitations to this review which are reflections of the global difficulties in evaluating the phase-oriented model. Firstly, the definitions of the terms phase-oriented and trauma complexity are wide ranging in the literature (Herman, 1992, Ford et al., 2005, NICE, 2005, Ford & Courtois, 2013), which was reflected in the treatment variation. Whilst all treatments used skills targeting emotion regulation, some studies also delivered Trauma Focused CBT (Bryant et al., 2013), interpersonal skills (Cloitre, 2002, 2010), and longer stabilisation durations in some instances (Harned et al., 2012, 2014). Due to the wide variation in both treatment type and measurement time points, the study could not reliably account for the efficacy of each individual phase, contributing to heterogeneity. There were also difficulties in defining complexity requiring a definition based on emerging evidence (Hyland et al., 2017). This meant that the high complexity sample were not a CPTSD sample but rather one based on risk for this pathology. This in turn reduced the validity of the high complexity sample, for which the phase-oriented model was intended. Finally, limitations lay in the methodology, in that this study only accounted for beginning and end of treatment time point measurements. This was due to studies using variable follow up periods and so lacked

comparability. Furthermore, a consistent and active control group used to measure treatments against could not be utilised as a comparator of effect size, although controls were sub-analysed to ensure consistency in findings.

Implications and future research

The results of this review point to the value of phase-oriented approaches, showing meaningful symptom changes through large effect sizes. This implies that it may be an efficacious practice for clinicians to first implement skills for those difficulties which are strongly associated with CPTSD, such as emotion dysregulation, which may have a moderating relationship with therapy outcomes. Secondly, it may be that this stabilisation phase supports the gains made in exposure and trauma memory reprocessing, although this requires further investigation and component analysis, as research is now beginning to develop (van Villet, Huntjens, van Dijk, & de Jongh, 2018). Third, the current analysis lends support to clinical guidelines advocating the use of a phase-oriented model using evidence-based stabilisation strategies, particularly in cases of CPTSD (McFetridge et al., 2017). The dissimilarity in treatment durations and content, both in terms of emotion regulation skills, as well as additional stabilisation strategies suggests a need for standardisation across content of phase-oriented treatments and comparing them with appropriate controls (de Jongh et al., 2017). Future research should seek to compare the phase-oriented approach with stand-alone exposure based protocols and pure unimodal therapies such as Trauma Focused CBT. More specifically, further investigations of the value of implementing emotion regulation components with PTSD exposure treatments would clarify key issues in the knowledge base (McClean & Foa, 2017). Most importantly, the review highlights the need to develop universal terminology for the phase-oriented approach, which then requires reliable testing at each phase of treatment and extended to follow up periods.

Conclusions

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Overall this systematic review of the literature somewhat confirmed the research which suggests that there may be therapeutic benefit in implementing emotion regulation skills before exposure and trauma memory reprocessing, and that this may be maintained when working with higher complexity PTSD presentations. This area can be developed through more clearly defining the phase-oriented approach and testing it against best practice, active treatment groups.

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Appendices

Appendix 1.

Forest plots for control groups and high complexity sample

Figure 3. Forest plot containing effect sizes and confidence intervals for overall meta-analysis with study control groups (where used).

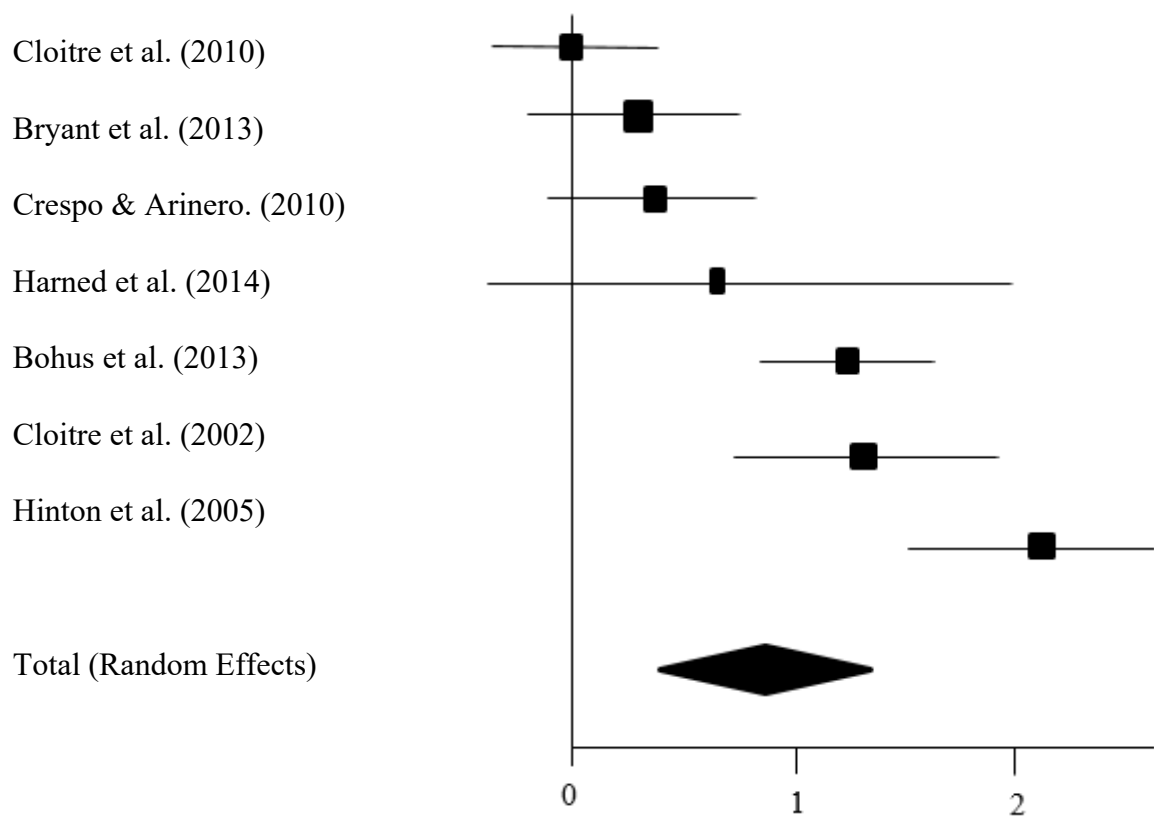
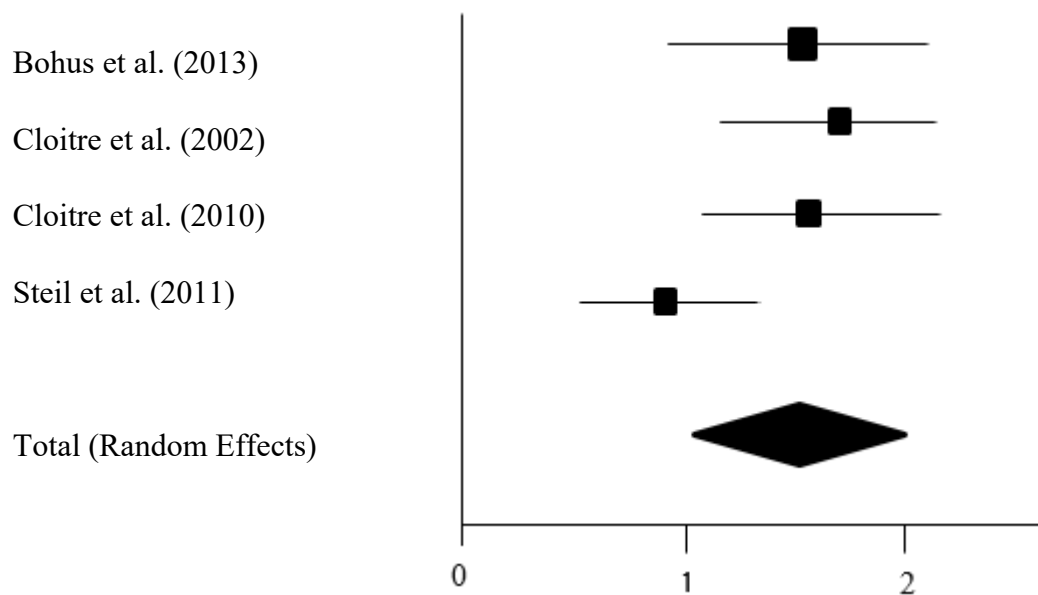


Figure 4. Forest plot containing effect sizes and confidence intervals for high complexity sample sub-analysis.



Appendix 2.

Quality assessment tool used for each study. Source: <https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools>

Quality Assessment Tool for Before-After (Pre-Post) Studies With No Control Group

Criteria	Yes	No	Other (CD, NR, NA) *
1. Was the study question or objective clearly stated?			
2. Were eligibility/selection criteria for the study population prespecified and clearly described?			
3. Were the participants in the study representative of those who would be eligible for the test/service/intervention in the general or clinical population of interest?			
4. Were all eligible participants that met the prespecified entry criteria enrolled?			
5. Was the sample size sufficiently large to provide confidence in the findings?			
6. Was the test/service/intervention clearly described and delivered consistently across the study population?			
7. Were the outcome measures prespecified, clearly defined, valid, reliable, and assessed consistently across all study participants?			
8. Were the people assessing the outcomes blinded to the participants' exposures/interventions?			
9. Was the loss to follow-up after baseline 20% or less? Were those lost to follow-up accounted for in the analysis?			
10. Did the statistical methods examine changes in outcome measures from before to after the intervention? Were statistical			

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Criteria	Yes	No	Other (CD, NR, NA) *
tests done that provided p values for the pre-to-post changes?			
11. Were outcome measures of interest taken multiple times before the intervention and multiple times after the intervention (i.e., did they use an interrupted time-series design)?			
12. If the intervention was conducted at a group level (e.g., a whole hospital, a community, etc.) did the statistical analysis take into account the use of individual-level data to determine effects at the group level?			

Quality Rating (Good, Fair, or Poor) (see guidance)
Rater #1 Initials:
Rater #2 Initials:
Additional Comments (If POOR, please state why):

Appendix 3.

Author Guidelines

1. **Online Submissions:** The *Journal of Traumatic Stress* accepts submission of manuscripts online at: <http://mc.manuscriptcentral.com/jots> Information about how to create an account or submit a manuscript may be found online on the Manuscript Central homepage in the "User Tutorials" section or, on the Author Dashboard, via the "Help" menu in the upper right corner of the screen. Personal assistance also is available by calling 434-964-4100.

2. **Article Formats:** Three article formats are accepted for consideration by JTS. All page counts should include references, tables, and figures. *Regular articles* (30 pages maximum, inclusive of all text, abstract, references, tables, and figures) include research studies, quantitative systematic reviews, and theoretical articles. Purely descriptive articles or narrative-based literature reviews are rarely accepted. In extraordinary circumstances, the editors may consider longer manuscripts that describe highly complex designs or statistical procedures but authors should seek approval prior to submitting manuscripts longer than 30 pages. *Brief reports* (18 pages maximum) are appropriate for pilot studies or uncontrolled trials of an intervention, preliminary data on a new problem or population, condensed findings from a study that does not merit a full article, or methodologically oriented papers that replicate findings in new populations or report preliminary data on new instruments. *Commentaries* (1,000 words or less) involve responses to previously published articles or, occasionally, invited essays on a professional or scientific topic of general interest. Response commentaries, submitted no later than 8 weeks after the original article is published (12 weeks if outside the U.S.), must be content-directed and use tactful language. The original author is given the opportunity to respond to accepted commentaries.

3. **Double-Blind Review:** As of January 1, 2017, the Journal of Traumatic Stress utilizes a double-blind review process in which reviewers receive manuscripts with no authors' names or affiliations listed in order to ensure unbiased review. To facilitate blinded review, the title

page should be uploaded as a separate document from the body of the manuscript, identified as “Title Page,” and should include the title of the article, the running head (maximum 50 characters) in uppercase flush left, author(s) byline and institutional affiliation, and author note (see pp. 23-25 of the APA 6th ed. manual). Within the main body of the manuscript, tables, and figures, authors should ensure that any identifying information (i.e., author names, affiliations, institutions where the work was performed, university whose ethics committee approved the project) is blinded; a simple way to accomplish this is by replacing the identifying text with the phrase “[edited out for blind review]”. In addition, language should be used that avoids revealing the identity of the authors; e.g., rather than stating, “In other research by our lab (Bennett & Kerig, 2014), we found ...” use phrases such as, “In a previous study, Bennett and Kerig (2014) found ...” Please note that if you have uploaded the files correctly, you will **not** be able to view the title page in the PDF and HTML proofs of your manuscript; however, the Editor and JTS editorial office staff can view this information.

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5. Publication Style: JTS follows the style recommendations of the 2010 *Publication Manual of the American Psychological Association* (APA; 6th edition) and submitted manuscripts must conform to these formatting guidelines. Manuscripts should use non-sexist language. Manuscripts must be formatted using letter or A4 page size, with 1 inch (2.54 cm) margins on all sides, Times New Roman 12 point font (except for figures, which should be in 12 point Arial font), and double-spacing for text, tables, references, and figures. Submit your manuscript in DOC or RTF format. For assistance with APA style, in addition to consulting the manual itself, please note these helpful online sources that are freely available:

<http://www.apastyle.org/learn/tutorials/basics-tutorial.aspx> and

<https://owl.english.purdue.edu/owl/section/2/10/> .

6. APA and JTS Style Pointers: In addition to consulting the APA 6th edition Publication Manual, the resources indexed above, and the JTS Style Sheet posted online, please consider these pointers when formatting each section of the manuscript:

- a. **Tense:** Throughout the manuscript, please use past tense for everything that has already happened, including the collection and analyses of the data being reported.
- b. **Abstract:** The Main Document of the manuscript should begin with an abstract no longer than 250 words, placed on a separate page. In addition, JTS house style requires the reporting of an effect size for each finding discussed in the abstract; if there are many findings, present the range.
- c. **Participants:** Please include in this subsection of the Method section information on sample characteristics, subsample comparisons, and analyses that describe the sample but are not focused on testing the hypotheses that are the aims of your manuscript.
- d. **Procedure:** Please describe the procedure in sufficient detail so that it could be comprehended and replicated by another investigator. Identify by name the IRB or ethics committee (edited out for blind review in the submitted manuscript) that approved the research, and the manner in which consent was obtained.
- e. **Measures:** In addition to providing citations, psychometric, and validation data for each measure administered, please provide coefficient alpha from your data for each measure for which this is appropriate.
- f. **Data Analysis:** Include a separate subsection with this header in the Method section in which you describe the analyses performed, the software program(s) used, and make an explicit statement about missing data in your data set. If there are no missing data, so state; otherwise describe the extent of missing data and how they were handled in the data analyses.
- g. **Results (and throughout):** Please present percentages to 1 decimal place, means and *SDs* to 2 decimal places, and exact *p* values to 3 decimal places except for $< .001$. Include leading zeros (e.g., 0.92) when reporting any statistic that can be greater than 1.00 (or less than -1.00). For example, there is no leading zero used when reporting correlations, coefficient alphas, standardized betas, *p* values, or fit indices (e.g., $r = .47$, not 0.47).

h. **References:** Format the references using APA 6th edition style: (a) begin the reference list on a new page following the text, (b) double-space, (c) use hanging indent format, (d) italicize the journal name or book title, and (e) list alphabetically by last name of first author. Do not include journal issue numbers unless each volume begins with page 1. If a reference has a Digital Object Identifier (doi), it must be included as the last element of the reference.

(1) Journal Article:

Kraemer, H. C. (2009). Events per person-time (incidence rate): A misleading statistic? *Statistics in Medicine*, 28, 1028–1039. doi: 10.1002/sim.3525

(2) Book:

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

(3) Book Chapter:

Meehl, P. E. (2006). The power of quantitative thinking. In N. G. Waller, L. J. Yonce, W. M. Grove, D. Faust, & M. F. Lenzenweger (Eds.), *Essays on the practice of scientific psychology* (pp. 433–444). Mahwah, NJ: Erlbaum.

i. **Footnotes:** Footnotes should be avoided. When their use is absolutely necessary, footnotes should be formatted in APA style and placed on a separate page after the reference list and before any tables.

j **Tables:** Tables should be formatted in APA 6th edition style and should be placed after the references in the body of the manuscript. Please use Word's Table function to construct tables, not tabs and spacing. Tables should be numbered (with Arabic numerals) and referred to by number in the text. Each table should begin on a separate page. Please make tables double-spaced, decimal align all numeric columns, and use sentence case for labels. Each datum should appear in its own cell (e.g., do not include *SDs* in parentheses following *Ms* but instead create a separate column for *SDs*). When reporting a table of intercorrelations, fill the rows first and then the columns such that any empty cells are in the lower left-hand quadrant of the table; use dashes in any redundant cells indicating the

correlation of a variable with itself. Please use asterisks to indicate significance levels in tables, not *p* values. **Color in tables:** Color can be included in the online version of a manuscript at no charge; however use of color in the print version of the journal will incur additional charges (currently \$600 per figure or table). If you wish to include color in only the online version, please ensure that each table will be legible in greyscale when it is published in the print version; for example, lines of different colors may be discriminable from one another when viewed in color but may not appear to be different from one another in greyscale.

k. **Figures:** All figures (graphs, photographs, drawings, and charts) should be numbered (with Arabic numerals) and referred to by number in the text. Each figure should begin on a separate page. Place figures captions at the bottom of the figure itself, not on a separate page. Include a separate legend to explain symbols if needed. Please use Arial font throughout except for the caption, which should remain as Times New Roman. Use sentence case for titles and labels. Figures should be in Word, TIF, or EPS format.

L. **Color in figures:** Color can be included in the online version of a manuscript at no charge; however use of color in the print version of the journal will incur additional charges (currently \$600 per figure or table). If you wish to include color in only the online version, please ensure that each figure will be legible in greyscale when it is published in the print version; for example, lines of different colors may be discriminable from one another when viewed in color but may not appear to be different from one another in greyscale.

7. **Uploading Files:** After the separate Title Page has been uploaded, the remaining text (abstract, main body of the manuscript, references, and tables) should be uploaded as a **single** file designated as “Main Document.” Figures may be either included in the main document or uploaded as separate files if in a non-Word format.

8. **Supplementary Materials.** Authors may wish to place some material in the separate designation of “Supplementary file not for review,” which will be made available online for optional access by interested readers. This material will not be seen by reviewers and will not

be taken into consideration in their evaluation of the scientific merits of the work, and will not be included in the published article. Material appropriate for such a designation includes information that is not essential to the reader's comprehension of the study design or findings, but which might be of interest to some scholars; examples might include descriptions of a series of non-significant post-hoc analyses that were not central to the main hypotheses of the study, detailed information about the content of coding system categories, and CONSORT flow diagrams for randomized controlled trials (see below). Note well that the manuscript must stand on its own without this material; consequently, critical information reviewers and readers need to evaluate or replicate the study, such as the provenance and psychometric properties of the measures administered, is not appropriate for placement into Supplementary Materials.

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Investigating Trauma Processing; the Development of Data-driven Processing and its Impact on Cognition

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Abstract

Whilst data-driven processing (DDP) during trauma has been shown to play a role in poor memory integration and is associated with Post-Traumatic Stress Disorder (PTSD) re-experiencing symptoms, the pre-trauma risk factors and related cognitive mechanisms are uncertain. This experimental study investigated predictors of DDP, as well as its role in attentional bias to threat and a free recall memory task, after exposure to a virtual reality (VR) trauma. Using a non-clinical sample (n=56), regression analysis demonstrated that trait dissociation at pre-exposure to trauma significantly predicted DDP. Analysis revealed an attentional bias towards threat related images. Consistent with theoretical accounts of PTSD, results showed that DDP and a breakdown in memory integration predicted attentional bias to threat images. However, contrary to the literature, results showed that higher levels of DDP actually predicted a higher overall score in the free recall task. This study showed that DDP is strongly linked to dissociative traits, and along with memory disintegration it may predict attentional changes after exposure to a trauma. Implications and limitations of findings are discussed.

Keywords: Post-Traumatic Stress, Cognitive processing, Attention, Memory

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Investigating Trauma Processing; the Development of Data-driven Processing and its Impact on Cognition.

Several models of Post-Traumatic Stress Disorder (PTSD) suggest that cognitive changes in PTSD are partially the result of poor integration and elaboration of the trauma memory into existing cognitive architecture (Brewin, Dalgleish, & Joseph, 1996; Ehlers & Clark, 2000; Power & Dalgleish, 1997). These theories suggest that a lack of integration leads to cognitive difficulties in freely accessing the memory as well as the involuntary activation of the memory, often triggered by sensory cues, causing a current appraisal of threat. Due to the highly perceptual way that trauma memories are encoded and stored, consciously accessing them becomes difficult, but trauma-congruent stimuli results in cue-driven memory prompts, which often lead to involuntary flashbacks (Brewin et al., 1996).

The mechanism behind memory integration in PTSD can be somewhat explained by an alteration in information processing. Roediger (1990) distinguished between two processing styles: 1) *conceptually-driven processing*, which involves processing the event in its entirety, creating meaning and accessible narrative; and, 2) *data-driven processing*, which accounts for the perpetual data input, and is sensory in nature. Theoretically, a prioritising of data-driven processing (DDP) is responsible for a breakdown in the meaning of the event and leads to stronger perceptual priming of traumatic material (Ehlers and Clark, 2000). This has been supported through one study which found that participants recalling traumatic events were less able to recall associated non-traumatic material, reducing their ability to contextualise the memory, creating a disjointedness effect (Kleim, Wallott & Ehlers, 2008) and suggesting a reduction in conceptually-driven processing. This incomplete memory integration has also been shown to be involved in PTSD symptom development (Mayou, Ehlers, & Bryant, 2001).

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In order to maintain experimental control and provide reliable and ethical investigations into peri-traumatic mechanisms, paradigms have used non-clinical analogue designs to examine trauma information processing symptomatology. For example, using a story memory task with induced dissociation in a student sample produced impairments in verbal memory (Brewin, Ma & Colson, 2013). Furthermore, a blurred object identification task with non-clinical participants was also used to identify neutral pictures with either neutral or trauma picture stories. Findings showed that higher levels of dissociation and DDP resulted in higher perceptual priming for the stimuli in trauma stories, and that this predicted intrusive memories (Sundermann, Hauschlidt, & Ehlers, 2013).

The findings of increased priming for trauma material may then suggest an attentional bias to threat after trauma exposure, possibly attributed to the on-going reactivation of fear networks (Foa and Kozak, 1986). This may perpetuate the maintained sense of current threat seen in PTSD. The proclivity for perceived threat has been attributed to heightened initial attentional capture (known as vigilance), and also a difficulty shifting attention away from (delayed disengagement) or over-fixating (maintenance) on threat. For example, through using an eye tracking methodology research has shown an increased number of initial eye fixations and increased dwell time on trauma images (Kimble, Fleming, Bandy, Kim & Zambetti, 2010), as well as increased attentional capture and difficulties disengaging with threat stimuli among samples of veterans with PTSD (Olatunji, Armstrong, McHugo, & Zald, 2013). Using experimental findings, increased vigilance for threat and maintenance of attention on these stimuli can be inferred, lending evidence to an attentional bias to threat in PTSD. Furthermore, research has also shown that increased attentional capture towards threat stimuli results in an associative learning, generalising attentional bias towards other threat congruent material (Acheson et al., 2015; Steiger, Nees, Wicking, Lang & Flor, 2015; Thome et al., 2017). Crucially however, the predisposing factors and cognitive mechanisms in the

development of attentional biases have not been investigated, and it remains unknown as to how DDP or memory integration influences its development.

To date the research on DDP has focused primarily on its disturbance of memory, given that memory changes are consistently found in PTSD (Johnsen & Asbjornsen, 2008). For example, individuals with PTSD symptoms have been shown to find it easier to remember perceptually orientated rather than conceptually orientated words (Lin, Hofmann, Qian, & Li, 2015), as well as a finding of a positive relationship between DDP and memory disorganisation in both student and clinical samples using free recall paradigms (Halligan, Clark & Ehlers, 2002; Kleim et al., 2008). Supporting this research, further studies on recognition tasks showed an increase in perceptual priming for neutral events if they preceded traumatic stimuli (Michael & Ehlers, 2007), consistent with Ehlers' and Clark's postulation that perceptually similar stimuli enhance cue-driven response in PTSD (2000). The study also showed that higher trait dissociation predicted stronger perceptual priming and state dissociation. However, whilst this is in keeping with dissociation being a strong predictor of PTSD symptoms (Ozer, Best, Lipsey, & Weiss, 2003), the study did not account for any other trait variables which may influence peri-traumatic processing, particularly anxiety. Also, the findings have failed to be consistently replicated, and conflicting research has shown that neither encoding disorganised memories, nor a focus on sensory processing predicts analogue trauma symptoms (Segovia, Strange, & Takarangi, 2016). Moreover, reviews of using methods such as trauma film paradigms have suggested that memory recall tasks are often unclear in measuring cognitive changes (James et al., 2016).

It should be noted, that whilst these aforementioned studies have produced insightful findings, there remains a range of methodological and theoretical shortcomings, which have resultantly created several gaps in the knowledge base. Some experimental paradigms employed may not be salient enough to induce significant levels of DDP, particularly in non-

clinical samples, suggesting a need for an emotionally salient paradigm which capitalises on optimal emotional salience to induce mechanisms such as DDP. Secondly, the causal nature of trait emotions on processing style has not been fully explored, which is problematic when such a relationship is important in highlighting cognitive vulnerabilities towards PTSD (Thrasher & Dalgleish, 1999). Third, whilst there are studies addressing information processing in memory integration, processing styles have not been studied in connection with attentional bias, even though attentional priming for threat is a theoretical mechanism in the maintenance of PTSD (Power & Dalgleish, 1997). Finally, free recall tasks and measures of DDP have been used in a minority of studies (Halligan et al., 2002; Halligan, Michael, Clark & Ehlers, 2003) and so have not been replicated. Whilst this may bring into question the validity of the findings, it also stresses the need for repetition among unstandardized memory measures.

Overall, investigations of DDP and its predisposing influences, as well as its effects on attention and memory have important theoretical and clinical treatment implications. For example, a higher amount of treatment drop-out has been found in psychological interventions for PTSD compared to present-centred controls (Imel, Laska, Jakupcak & Laska, 2013), and known exposure treatments are suggested as not leading to complete improvements in therapeutic interventions (Tarrier et al., 1999). Therefore, there is clinical importance in exploring the role of DDP to inform trauma treatments, especially given that underlying causal mechanisms have been stated as imperative to the development of effective interventions (Craig et al., 2008). Investigating the DDP mechanism could also provide clinical insight into how trauma processing strategies could be used in the immediate aftermath to trauma exposure. The current understanding of this mechanism also underpins fundamental assumptions on which trauma theory is based, thus modifying models which guide clinical practice. Moreover, having a working knowledge of the cognitive risk factors

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to trauma symptomology, as identified by experimental designs, would allow for better identification of at risk groups. These experimental designs may also serve as potential pathways for intervention development and measurement of symptom improvement if understood more thoroughly.

The rationale for the current study built on previous research which has emphasised DDP in memory processes after experiencing a traumatic event. Currently only a minimal number of studies have considered trait predictors to DDP (Michael & Ehlers, 2007). Also, no research has sought to explore how DDP influences attentional changes, leading the cognitive research in PTSD to be somewhat fragmented. Studies have also not been able to utilise immersive analogue traumas, relying heavily on trauma film or story paradigms, and so the use of immersive virtual reality (VR) is a promising platform to simulate an analogue trauma. Investigating trait predictors and how DDP impacts both memory and attention through technologically appropriate means, offers clarification on the theoretical models on which clinical practice is based. Finally, advanced attentional methodologies such as eye tracking have not been used to explore whether peri-traumatic processes, such as DDP, predict attentional bias. Therefore, research has not yet examined the formations of attentional biases and links to DDP, or how these biases develop from pre to post trauma.

For the current study, an experimental design was employed using virtual reality (VR) to deliver an immersive video and measured cognitive changes. The study aimed to measure if DDP as a peri-traumatic processing style had predisposing trait variables, namely trait anxiety and trait dissociation. It then aimed to investigate if there was an attentional bias towards threat related images after exposure to a trauma through measuring eye gaze. A further aim was then to measure if this attentional bias to threat was caused by DDP and other factors. Finally, the study aimed to measure if the ability to recall the traumatic event after exposure was influenced by DDP.

Method

Participants

The study utilised a non-clinical population, obtained via opportunity and snowball sampling in a university setting. Inclusion criteria were; aged 18 years of age or above, and normal or corrected to normal vision. Exclusion criteria were; if a participant had been involved in a road traffic collision, which was asked specifically at the screening stage, and if a participant met diagnostic threshold for PTSD. In total, 72 individuals volunteered for the study; however, 16 potential participants were ineligible based on selection criteria. Fifty-six participants (13 males; 43 females) aged 18 to 28 years old participated in the study (*Mean* 19.74; *Std* = 3.22). The sample was composed of university students (n=48, 86%) and the general population (n=8, 14%). All participants were either in higher education or had completed higher education. The study received ethical approval from the School of Psychology, Queens University Belfast (Appendix 1).

Materials/Apparatus

Post-Traumatic Stress Diagnostic Scale (PDS; Foa, 1995).

This is a 49 item self-report measure, assessing PTSD symptom severity and diagnostic threshold, relating to self-disclosed traumatic life experiences. The measure first provides a short checklist of potentially traumatic experiences and measures PTSD severity in the areas of intrusive thoughts, avoidance, and arousal as they pertain to the DSM-IV diagnostic categories for PTSD. The PDS is reported to have high internal consistency and high convergent validity has also been found with other trauma measures (Cronbach's $\alpha=0.92$; Foa, Cashman, Jaycox & Perry, 1997).

State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970).

The STAI is a 40 item self-report measure used to distinguish between situational state anxiety (items 1-20) and trait anxiety (items 21-40). The items are scored between 1 (not at all) and 4 (very much so) and are a measure of frequency. High internal consistency has also been found in a student sample (Cronbach's $\alpha=0.93$; Fonseca-Pedrero, Paino, Santarén-Rosell, Lemos-Giráldez, & Muñiz, 2012). The STAI has also shown convergent validity in demonstrating significant correlations with other anxiety measures (Gorss, Anthony, Simms & McCabe, 2007).

Dissociative Experiences Scale II (DES II; Carlson & Putnam, 1993)

This 28 item self-report measure is designed to assess trait dissociation in both clinical and non-clinical samples in clinical and research settings. The scale measures the frequency of dissociative experiences, asking a participant to rate how often they experience a certain event between 0% and 100%, with increments of 10. It is a measure of trait dissociation, rather than a measure of states. The DES-II is reported to have high internal consistency in a student sample (Cronbach's $\alpha=0.92$; Zingrone & Alvarado, 2001). In studies investigating convergent validity, the DES correlates significantly with measures of dissociative states (Frischholz et al., 1992).

Data Driven Processing Scale (DDPS; Ehlers, 1998).

This 8 item self-report scale is used to measure perceptual levels of processing (Appendix 2, figure 1). It measures the extent to which the participant processed the event in a perceptual and sensory form. It is reported to have satisfactory internal consistency in a student sample who were part of an analogue trauma study (Cronbach's $\alpha=0.69$; Halligan, Clarke, & Ehlers, 2002), and has shown high internal consistency in other research (Cronbach's $\alpha=0.88$; Halligan et al., 2003). It has also been shown to predict disorganised recall of events

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in survivors of road traffic collisions (Murray, Ehlers, & Mayou, 2002), and predictive of PTSD symptoms in participants of analogue trauma studies (Halligan et al., 2002).

Personal Relevance Scale (PRS).

Consistent with other research which has used road traffic collision footage in analogue trauma, a measurement of personal relevance was included, as this may influence the way in which a participant processes the event (Bourne, Frاسquilho, Roth, & Holmes, 2010). Participants were asked to rate their experience from 0-100 in terms of the film's personal relevance to them (0 = no relevance, 100 = very relevant).

Virtual Reality Film

As the method of analogue trauma exposure, a 360-degree immersive film was delivered via VR technology and developed by a UK fire and rescue service to encourage safer driving behaviour in young adults. Therefore, it has been used to elicit a certain level of response and promote positive behaviour changes in non-clinical samples, but not to the detriment of a person's psychological wellbeing. The immersive format used a VR headset to play the footage. The footage was approximately 6 minutes in duration and observed from a first-person view. The viewer observed in first person a car journey and road traffic collision. Several passengers are injured requiring ambulance and fire crews to attend to them (<http://www.leicestershire-fire.gov.uk/your-safety/road-safety/vf4-360/>).

Memory task

The memory task employed was adapted from Halligan et al. (2002), which used an incidental free recall task that was audio-recorded for scoring. Participants were given instructions to recall the events in the Virtual Reality Film, starting at the beginning. Events in the video were then scored on a scoring index for amount of information correctly recalled (*event content score*) and whether it was recalled in the correct order (*event order score*).

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(Appendix 3, Figure 2). These two items added together formed an *overall memory score*. In order to validate the scoring indices, five independent volunteers watched the video and piloted the memory task. The research team then listened to the recordings and concurred if the detail accurately matched the indices.

Attentional Stimuli

Four sets of attentional images were developed and labelled based on the content of the video footage to create four areas of interest. First, 40 images of road traffic collisions (*trauma aversive images*), 20 images of generally aversive images (*general aversive images*), 20 images of neutral traffic related images (*trauma neutral images*), and 40 non-specific neutral images (*general neutral images*) were compiled. These images were gathered through online searches, researcher photographs from a road safety event, as well as from the International Affective Picture System database (IAPS) (Lang, Bradley, & Cuthbert, 1997); a database of standardised images for the study of emotion and attention. In order to ensure the trauma aversive images met a certain threshold, five independent judges rated the images for averseness and anxiety provocation on a 1-5 Likert scale. Only those images rated 3 or above were included. Images were then paired in sets of two, creating 60 slides. 20 slides contained trauma aversive images matched with general aversive images, 20 contained trauma neutral images matched with general neutral images, and 20 contained trauma aversive images matched with general neutral images (example of matched stimuli appendix 4). Paired images were matched for complexity, were alternated between the right and left sides of the slide, and slides were ordered randomly. A central fixation cross was presented in between each slide to re-orientate the viewer's gaze back to a baseline position.

Eye Tracking Equipment.

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Video-based combined pupil and corneal reflection technique was used to assess eye-movement with the iView X Remote Eye Tracking Device (RED250) from SensoMotoric Instruments (SMI). This methodology allows measurement of attentional bias through examining eye fixations. These fixations are then interpreted as a vigilance, delayed-disengagement, or a maintenance bias, depending on the type of fixation that occurred.

Measures of Attentional Bias

In order to examine the nature of the attentional bias, four fixation types were examined for 3 forms of attentional bias, as outlined in a previous methodology (Bradley et al., 2016).

1. Measures of vigilance were the *direction of the first fixation* and the *frequency of first fixation* on each area of interest.
2. Measure of a delayed disengagement was the *duration of the first fixation* on each area of interest.
3. Measure of maintenance was the *total fixation time* on the area of interest.

Procedure.

Potential participants were initially screened using the PDS and a screening question, asking if they had been involved in a road traffic collision. Individuals meeting selection criteria were invited back to take part in the experiment. Each participant completed the STAI (trait) and the DES-II initially. A 9-point calibration was carried out with the participants on the eye-tracking equipment in order to ensure gaze accuracy. Participants were then given a brief instruction to view the images presented to them in whatever way they like but to return their gaze to the fixation cross after each slide. The slides were presented over approximately four minutes, with each slide being presented for 2000ms and eye movements were recorded (pre-measure). Once the pre-measure was complete, participants were then exposed to the VR film. Participants then completed a battery of assessments (i.e., DDPS, PRS, and memory

task) followed by a second exposure to the images via the eye tracking procedure (post measure).

Results

Descriptive Statistics

Table 1 shows the descriptive statistics for each of the questionnaire-based variables based on the sample who completed the study (n=54). Minimum and maximum scores on each measure are provided along with the mean scores and standard deviations.

Table 1. Descriptive statistics for questionnaire-based variables.

Variable	Minimum	Maximum	Mean	Std. Deviation
STAI Trait	24	65	40.56	8.86
DES	50	1350	433.69	312.97
PRS	0	75	11.65	18.71
DDPS	1	27	10.78	6.17
Event Order	4	18	9.61	3.310
Event Content	8	49	22.83	9.53
Overall Memory	13	65	32.30	12.379

Analysis

Backwards stepwise regression was used to identify if there were trait predictors of DDP, namely trait anxiety and trait dissociation. In order to determine if an attentional bias to

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threat developed, four one-way MANOVAS were conducted to analyse the differences from pre to post time points in each of the fixation types, as they pertained to their types of orienting bias respectively (vigilance, delayed disengagement, and maintenance), across the 4 areas of interest (trauma aversive, trauma neutral, generally aversive, and generally neutral). Where significance was found on a fixation type, indicating a particular orienting bias, backwards stepwise regression was used to identify predictors of that particular bias towards the areas of interest which showed an increase from pre to post measurement. Backwards stepwise regression was then used to analyse which variables predicted overall memory score. The backwards stepwise method was used due to the high number of variables and exploratory nature of the design. For each regression the assumptions were checked and deemed to be satisfactory.

Trait predictors of DDP.

Variables entered into the regression to identify trait predictors of DDP were trait anxiety and trait dissociation. The final regression model was statistically significant ($F(1,53) = 22.80, p < .001$), with trait dissociation the only significant predictor of DDP ($\beta = .55, t(4.78), p < .001$) explaining 29.1% of the variance of the DDP criterion. Backward selection removed trait anxiety from the final model.

Attentional changes between pre and post time points.

When measuring direction of the first fixation, the frequency of first fixation, and duration of first fixation MANOVAs were used to identify vigilance and delayed disengagement biases between pre and post time points for each area of interest. No statistically significant model was found, and so no further analyses were completed for these biases. The MANOVA analysing total fixation time revealed that there was a statistically significant change between pre and post time points, based on Pillai's Trace ($F(1,4) = 4.49, p < .005, \eta_p^2 = .26$), indicating

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a maintenance bias. Changes in total fixation time from pre to post were statistically significant indicating an increase in total fixation time for trauma neutral ($F(1,53) = 7.94$, $p < .05$, $\eta_p^2 = .13$) and trauma aversive images ($F(1,53) = 7.42$, $p < .05$, $\eta_p^2 = .12$), and a decrease in total fixation time for general aversive ($F(1,53) = 9.74$, $p < .05$, $\eta_p^2 = .15$), and general neutral images ($F(1,53) = 8.53$, $p < .05$, $\eta_p^2 = .14$). This increase of total fixation time on trauma images and decrease of total fixation on general images time can be seen in the descriptive statistics in table 2.

Table 2. Mean total fixation times and standard deviations at pre and post time points.

Variable (Total Fixation Time)	Time	Mean	Std. Deviation
Trauma Neutral	Pre	767.65	134.58
	Post	825.37	162.65
	Total	769.51	151.38
Trauma Aversive	Pre	803.96	143.50
	Post	860.76	174.87
	Total	832.36	161.75
General Aversive	Pre	780.08	122.12
	Post	733.92	135.23
	Total	757.00	130.32
General Neutral	Pre	743.98	140.34
	Post	697.24	175.70
	Total	720.61	159.99

Predictors of attentional bias.

As the study aim was to measure predictors of attentional bias to threat, regression analysis was used to identify predictors of the difference in total fixation time for trauma neutral and trauma aversive images only (Table 2). Variables entered were trait anxiety, trait dissociation, DDP, event content score, event order score, and personal relevance. No statistically significant model was found for predicting total fixation time for trauma neutral images. The analysis determining predictors of total fixation time on trauma aversive images revealed a statistically significant final model ($F(2,53) = 4.22, p < .05$). The backward selection eliminated trait anxiety, trait dissociation, event content score, and personal relevance. Table 3 shows that DDP remained as a substantial predictor of orienting bias in the final model but was not statistically significant ($\beta = .24, t(1.80), p = .07$). The inability to recall the event in the correct order was a statistically significant predictor ($\beta = -.35, t(-2.62), p < .05$). Remaining predictors explained 10.8% of the variance in the difference in total fixation time for trauma neutral and trauma aversive images.

Table 3. Multiple linear regression with backward elimination for predictors of total fixation time on trauma aversive images.

	B	SE B	β	<i>t</i>	R^2	Sig. (<i>p</i>)
					.10	< .05
Data-driven Processing	5.98	3.31	0.24	1.80		0.07
Event Order	-16.14	6.16	-0.35	-2.62		0.01

Predictors of memory recall.

Variables entered to identify predictors of overall memory score (event content plus event order) were trait anxiety, trait dissociation, DDP, and personal relevance. The analysis revealed a final model which was statistically significant ($F(2,53) = 4.22, p < .05$), with the adjusted R^2 indicating that the model explained 10.8% of the variance. Table 4 shows that remaining significant predictors of increased overall memory score were a reduced personal relevance of the video ($\beta = -.28, t(-2.12), p < .05$), and increased DDP ($\beta = 0.26, t(2.01), p < .05$). Variables eliminated were trait anxiety and trait dissociation.

Table 4. Final model for multiple linear regression with backward elimination for predictors of overall memory score.

	B	SE B	β	<i>t</i>	R^2	Sig. (<i>p</i>)
					.99	< .05
Personal Relevance	-0.18	0.09	-0.28	-2.12		0.03
Data-driven Processing	0.52	0.26	0.26	2.01		0.04

Discussion

This study showed that DDP is strongly predicted by trait dissociation, rather than trait anxiety, and that this peri-traumatic processing style along with the inability to recall events in their temporal order, is predictive of an increase in overall fixation time on threat images after exposure to a VR trauma. This would indicate a maintenance bias towards threat, rather than vigilance or delayed disengagement. Counter to findings showing that increased DDP impacts the ability to recall events, the current findings revealed an opposite direction of effect, in that higher levels of DDP resulted in a higher level of recall.

In terms of trait predictors, the current study showed that trait dissociation predicted DDP at a statistically significant level. Additionally, the findings distinguished between trait dissociation and trait anxiety, indicating that dissociation is predictive of this peri-traumatic information processing method, as opposed to anxiety. This implies that a dissociative mechanism is involved in the increasing of peri-traumatic DDP which in turn may lead to the difficulties seen in PTSD. This concurs with previous findings which showed that trait dissociation predicted higher levels of state dissociation and perceptual priming (Michael & Ehlers, 2007). Dissociation has also been shown to play a key role in symptom development in survivors of road traffic collisions (Murray et al., 2002). The clinical implications of this are highlighted by research which has shown that peri-traumatic dissociative processes impact memory (Brewin, Ma & Colson, 2013), and are among the strongest predictors of PTSD (Ozer, Best, Lipsey, & Weiss, 2003). These findings indicate that dissociation is a potential risk factor for developing post-traumatic stress difficulties. However, in showing that trait dissociation predicts both DDP in this study, as well as state dissociation in previous studies, the interaction between state dissociation and DDP remains unclear.

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The current study found an attentional bias towards direct threat represented by trauma aversive images, in the form of an increase in total fixation time, demonstrating a maintenance bias. This suggests that a person is primed for maintained attention through an increased maintained fixation to threat related images in the environment after trauma exposure. This concurs with previous research findings of increased fixation times on threat images in PTSD (Kimble et al., 2010; Olatunji et al., 2013), and in other anxiety disorder presentations (Bradley, 2016). The current study also found a further generalised attentional bias to general trauma congruent images (represented by trauma neutral images) suggesting associative learning in trauma exposure and the presence of strong S-S associations (Ehlers & Clark, 2000). The implication of a generalised attentional bias is consistent with findings which have shown generalisations of fear responses in PTSD populations (Acheson et al., 2015; Steiger, Nees, Wicking, Lang & Flor, 2015; Thome et al., 2017). Importantly, the current study controlled for generally aversive images that could cause aversive emotional responses.

In terms of predictors of attentional bias, none of the variables predicted the generalised threat bias, which may be attributed to trauma neutral images being less emotionally salient, although other cognitive processes may have been involved here. Whilst DDP was not a statistically significant predictor of fixation on trauma aversive images, it remained a substantial predictor within the overall significant model. Moreover, the inability to recall the event in the correct order was a significant predictor of the attentional bias towards the trauma aversive images. This implies that the nature of the poor memory integration, i.e. a temporal deficit, decreases the threshold for the perception of threat, concurring with theoretical discourse (Brewin, Dalgleish & Joseph, 1996; Ehlers & Clark, 2000). The processing of the temporal order of events has also been shown as important in how well a memory is recalled (Kleim et al., 2008; Wegner, Quilian, & Houston, 1996), and

therefore it is tentatively suggested that limited temporal integration of memory could partially predict threat appraisals in trauma presentations.

Although verbal memory impairment has been consistently found in adults with PTSD (Johnsen & Asbjornsen, 2008), this study found that higher levels of DDP after exposure did not predict deficits in free recall. The current findings are somewhat in keeping with research by Segovia et al (2016), who also found that an increased focus on data-driven information did not predict memory distortion or increased trauma symptoms in an analogue study. But the current findings also showed an opposite effect, in that increased DDP produced better recall, which is conflicting with previous studies (Ehlers, Mayou & Bryant, 2001; Halligan, Clark, Ehlers, 2002). These contradictory findings may be explained by considering methodological constraints of the study. Specifically, studies have shown that immediate recall of traumatic events results in a higher amount of correctly recalled information, compared to delayed recall (Gittins, Paterson, & Sharpe, 2015). This can be explained by the memory amplification effect, in that the ability to discriminate between true and false memories over time reduces after exposure to analogue trauma (Oulton, Takarangi, & Strange, 2016). Therefore, there may have been a time delay effect on how DDP influenced memory which was not picked up in the current methodology. It may also be that there is a theoretical explanation for higher DDP predicting better recall. It could be suggested that in cases of processing trauma, higher DDP as well as higher conceptual-driven processing occurs, and therefore an increase in both processing styles occurs. However, in those people who develop post-trauma cognitive changes and symptoms, it is the ratio of DDP to conceptual-driven processing that is central i.e. an increase in DDP but a decrease in conceptual-driven processing. This would be in keeping with trauma theory, suggesting that it is also the lack of narrative that produces memory disorganisation, rather than simply and increase in DDP. Given that less personal relevance of the video also predicted higher scores

on memory recall, may also have meant that the participant was better able to attend to the images, and process them conceptually, rather than engage in a processing style which may impact the ability to integrate the memory. On the other hand, a higher level of personal relevance may represent a more personal meaning of the experience, making it more distressing, and so a reduced ability to process the information conceptually, integrate, and recall it coherently.

This study provided further understanding of trauma mechanisms in a number of key ways. Firstly, through showing clearly that trait dissociation plays a causal role in the induction of DDP, it has become clear that this is a key cognitive pre-requisite to the unfolding of the peri-traumatic processing which leads to PTSD. This gives clinical indication as to the cognitive risk factors for developing PTSD. Secondly, the establishment of a maintenance bias after trauma exposure explains the hypervigilance to threat found in PTSD and shows that these difficulties are not due only to a propensity towards general aversion, but rather are threat specific. Furthermore, the finding of a generalised and specific threat bias provides an understanding that the concept of matching threat or cue dependent retrieval in cognitive models (Brewin, Dalgleish & Joseph, 1996; Ehlers & Clark, 2000) becomes activated through both specific and associative cognitive networks. Through showing that this threat bias develops when temporal memory organisation breaks down also suggests that temporal memory disorganisation is a key component in the development of proclivity to threat detection, as opposed to processing style alone. These findings support cognitive treatments in understanding environmental triggers to threat, which may re-active fear networks (Foa & Kozak, 1986), giving rise to re-experiencing symptoms of unintegrated memories. Further research, using experimental paradigms could investigate further the common and distinct factors influencing memory and attention in PTSD, specifically more extensive investigations of DDP and dissociation, but also investigating the potential role of

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conceptual-driven processing as a buffer of memory integration and attentional change. An investigation of how trauma memories develop over time and how peri-traumatic processes influence this would also give further indications of optimal time for therapeutic intervention.

Limitations

This study had several limitations. Whilst the use of a non-clinical sample was appropriate for methodological and ethical purposes, it is not possible to say how well these findings would translate to clinical populations, although the results do coincide with clinical findings. Secondly, the sample mainly consisted of students, and all other participants had been through higher education. This suggests a lack of representativeness in the sample, which reduces generalisability. The measures of data-driven processing and memory used were not standardised and methodologies were adapted from other studies, which limits their reliability and validity. Finally, other variables were utilised and measured, such as state anxiety, as a means to measuring state response to the film stimuli. However, due to the high number of variables already present, state mood measures not included in order to preserve the statistical power and to focus on the particular aims of the study, which were already wide ranging. Therefore, future studies could increase the sample size and develop research aims around the state responses to analogue traumas and their effects on cognitive difficulties.

Conclusions

Overall, this study elaborated and supported previous findings showing predictive factors to DDP as well as post trauma attentional changes. The study also showed that there is an influential role for DDP and memory integration in attentional changes. The contentious findings on DDP's influence on recall ability highlights the need for further research in the area, considering other cognitive influences. Finally, it highlights the need to consider further

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how attention and memory interact, as well as the similar and distinct factors influencing their changes after exposure to trauma, and how this guides treatment.

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Appendices.

Appendix 1.

Ethical Approval from School of Psychology, Queens University Belfast.



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30 August 2016

Mr John-Paul Corrigan
C/o School of Psychology

Dear John-Paul

Full title of Study: Investigating trauma Processing; the Development of Data-Driven Processing and its impact on Cognition.
PREC reference number: No 06-2016-17

Thank you for your response to our request for further information regarding the above mentioned research application.

I can confirm that ethical approval has been granted for your project by the School of Psychology Research Ethics Committee, on behalf of Queen's University Belfast.

Please note that the Participant Information sheet should include an appended statement confirming ethical approval.

It is the responsibility of the Chief Investigator to ensure that the research has been recorded on the University's Human Subjects Research Database otherwise it will not be covered by the University's indemnity insurance. This database can be found in the 'My Research' section of Queen's On-line.

Yours sincerely

Dr Eugene O'Hare (Chair)
Psychology Research Ethics Committee

Cc Dr D Hanna, Dr K Dyer

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Appendix 2

Figure 1. Data-Driven Processing Scale.

In this questionnaire, we are interested in WHAT WENT THROUGH YOUR MIND during the traumatic event. Please indicate the extent to which the following statements applied to you DURING THE TRAUMATIC EVENT.

DURING THE TRAUMATIC EVENT...	Not at all	This applied to me			
		A little	Moderately	Strongly	Very strongly
1. I couldn't really take it all in.	0	1	2	3	4
2. I did not fully understand what was going on.	0	1	2	3	4
3. It was just like a stream of unconnected impressions following each other.	0	1	2	3	4
4. I could not think clearly.	0	1	2	3	4
5. I was overwhelmed by sensations and couldn't put everything together.	0	1	2	3	4
6. I was confused and could not fully make sense of what was happening.	0	1	2	3	4
7. My mind was fully occupied with what I saw, heard, smelled, and felt.	0	1	2	3	4
8. My mind was full of impressions and my reactions to them.	0	1	2	3	4

Appendix 3.

Figure 2. Memory task scoring indices.

Segment Event Descriptor	Event Content	Order	Event Order	Overall Memory Score
1. Passenger travelling in car. Number of passengers, description of passengers, description of surroundings.	/4		0 / 1	/5
2. Conversation. Conversation content, nature of conversation, who is saying what.	/4		0 / 1	/5
3. Driver avoids pedestrian. Drivers language, where pedestrian comes from, description of pedestrian.	/4		0 / 1	/5
4. Driver using mobile phone. What is on the mobile phone, what driver is saying, passengers reactions to mobile phone.	/4		0 / 1	/5
5. Driver approaching tunnel. Description of the road, description of the tunnel, description of surroundings.	/4		0 / 1	/5
6. Driver turns onto another road. Direction turned onto, description of surroundings of road, description of buildings.	/4		0 / 1	/5
7. Driver loses control of car. Sounds being made by car, driver's reaction, passengers' reactions.	/4		0 / 1	/5
8. Tractor appears. Description of tractor, where it appears from, what happens to screen (flickering).	/4		0 / 1	/5
9. Crash occurs. Sound of bang, passengers shouting, what happens to screen (goes black).	/4		0 / 1	/5
10. Acknowledgement of a crash scene. Blood and glass, passenger through front window, condition of other passengers.	/4		0 / 1	/5
11. Paramedic at scene. Description of paramedic, what she is saying, other people's locations/conditions.	/4		0 / 1	/5

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12. Ambulance arrives. Sirens, where ambulance parks, description of ambulance.	/4		0 / 1	/5
13. Paramedic attends to other passengers first. What she asks them, what they are saying, and their physical appearance.	/4		0 / 1	/5
14. Fire crew arrive. Where fire crew park, description of fire crew, responders' locations/ actions around the car.	/4		0 / 1	/5
15. Paramedic attends to/treats driver and rear passenger. Taking blood pressure, pain relief, what paramedic is saying	/4		0 / 1	/5
16. Paramedics/crew slide front window passenger onto board, description of board, of crew, description of passenger being carried out	/4		0 / 1	/5
17. Front passenger carried away on stretcher. Location of stretcher, attempts to resuscitate, number of attendees.	/4		0 / 1	/5
18. Paramedics continue to talk to/ treat driver/ rear passenger. What paramedic is asking passenger (what can you remember, any drugs or alcohol? Any dizziness or sickness?)	/4		0 / 1	/5
19. Fire crew remove roof. What crew are now wearing, change in day light, helicopter flies overhead.	/4		0 / 1	/5
20. Paramedic attends to viewer. Injection given, location on body, description of paramedic	/4		0 / 1	/5
21. Heart rate listened to. Colour of stethoscope. What paramedic is saying, where stethoscope is placed.	/4		0 / 1	/5
22. Second injection given. What this is for, (to stop from feeling sick), what paramedic is asking (pain, drowsiness).	/4		0 / 1	/5
Paramedic continues to treat/ video ends				
Totals				

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Appendix 4. Example of matched stimuli.

1. Trauma neutral paired with general neutral
2. Trauma aversive paired with general aversive



3. Trauma aversive paired with general neutral



Appendix 5.

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Author guidelines for submission to the Journal of Anxiety Disorders

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Reflective Appendices

The overall experience of conducting this research has been mainly enjoyable, and reading it provides a sense of achievement. There were both successes and challenges throughout the research journey which provided opportunity for reflection. These pivotal points were recorded in reflective notes to assist with this reflective piece and to help consolidate research skills. This reflective piece focuses on the process of conceptualising the project, the design, gathering data, and disseminating findings.

The conception of the project was largely informed by my own interests in cognition and mechanisms around mental health presentations/treatments, an area which is seldom investigated in the field. I often feel curious when reading impressive and well-funded Randomised Control Trials showing that a treatment works, but little evidence as to why it works. Therefore, this research for me was about trying to contribute a body of evidence on the mechanisms behind trauma theories for the large-scale project, as well as testing a long-standing, yet widely debated and unclear intervention method in the systematic review. Inevitably the decision to focus on mechanisms brought challenges which are inherent in this type of research. For example, with the large-scale project there was a risk that it could be reduced to a piece of academic, cognitive psychology research, rather than something which was clinically relevant. This argument is further accentuated by use of a non-clinical sample, and so the rationale had to be weighed up very clearly. In order to resolve these uncertainties, I consulted my research supervisors, and we talked at length about the similarities in previous research and the clinical importance of what I was doing. As there were no straight forward solutions, these conversations really encouraged me to engage deep in thought about the philosophy behind the research which developed my problem solving and critical faculties.

The design of both studies were significant tasks and required a lot of commitment. The experimental design of the large scale project provided a steep learning curve, as this demanded very fine attention to detail in order to develop my own experimental paradigm. This involved discussion with PhD and technical members of the university. I think that my interest in the area was what allowed me to strive to make each step in developing the paradigm, rather than becoming flustered by

working with such fine detail. I noted several times just how tricky it can be to get experimental work right, and learned that there really is no such thing as perfect research. The design of the systematic review however was possibly the most taxing. I was acutely aware that this model is advocated throughout the world, but only defined in very loose terms and delivered in many different ways. Therefore, trying to evaluate it in a systematic fashion created quite the paradox. Creating search terms and definitions for this piece meant trying to find consistency in a very inconsistent treatment model. This was accomplished through scoping searches of literature and my own extensive reading in the area. I also ran many alternatives of the search strategy to ensure I was using the optimal search terms. In order to ensure that I didn't get lost in this, I took a number of steps, including regular discussions with the research team and establishing contact with prominent researcher-clinicians in the field who have tested the phase-oriented model. Whilst stressful at times, this experience ultimately provided crucial skills in scientific objectivity, time management, attention to detail, and networking.

Gathering data has been a time consuming process for both pieces of work. In terms of using an experimental design this required some commitment from participants. Having to use study days, and some evenings to work with participants and collect data was at times hard work, but as this was a novel task for me I took enjoyment and interest in it. I did notice a time of feeling particular stress when trying to balance the projects, as at times I felt lost in the two data sets. This highlighted the importance of a self-care schedule for me, and I had to allow myself to take regular breaks from the process in order to maintain my enthusiasm and commitment. Some anxieties came towards the end of data gathering, as I feared I would run out of participants, or not find enough studies for my meta-analysis. On reflection I think that this is an innate anxiety to working to deadlines, as well as the gravity of this piece of work.

Disseminating my findings has certainly been the most enjoyable and rewarding piece of work for me. So far I have presented the findings of my large scale project on two occasions, and have had many conversations and debates about my meta-analysis. These experiences have certainly brought my research to life, and reinforced my satisfaction for contributing to the field. Although,

having presented previous research findings in other training contexts, I have a strong sense that when people read or hear about a study they don't get to see the range of emotions and thoughts which are expressed from the early stages. I do however feel that presenting findings through presentations and publications is the most rewarding part of the journey for me, both as a primer for lively debate and discussion, but also as a celebration of hard work.